Also, the proverb that a south wind brings rain, might well be supplanted by the more accurate statement that it is the west wind which brings the rain; for both the rain and the southerly surface wind which attends it are, in a sense, by-products of the falling pressure for which the westerly current aloft is directly accountable.

While the foregoing applies with fewest exceptions to elliptical or trough-shaped depressions, it is germane to depressions of nearly all types, provided they are of large area. It does not seem to apply to many small depressions which sometimes form over the Far West and which present the aspect of a vortex up to the highest level sounded by the aerological net, viz, 14,000 feet. Counter currents do not appear to be accountable for their formation or maintenance; at least none are evident up to the height mentioned. What transpires above is conjectural, but the fact that the cyclonic circulation in such cases is always observed at the high levels prior to the development of falling pressure and unsettled weather at the surface certainly points to the general hypothesis that cyclones of the Far West are of high level origin, although it does not explain how those which appear as a vortex at 14,000 feet above sea level were generated.

But not all small depressions present a vortical circulation aloft. Those, for example, which sometimes appear off our southern coast are also often conspicuously identified with west or southwest winds in advance of them, i. e., over Arizona and New Mexico, but instead of the air current in their rear being from the northwest or north-northwest as in the case of large eastward moving cyclones of higher latitudes, the free-air winds are often from the north-northeast. Cyclones of this type are accompanied by high pressure at sea to the northward, the main axis of the anticyclone lying in a northeast-southwest direction with the cyclone on its equatorial side. It is important to note that so long as the upper winds in the northeast quadrant of such a cyclone continue to blow from the northeast or north-northeast, the disturbance lingers off the southern California coast (either the original one or a successor); whereas as soon as the winds referred to lose their east component and veer to the north and northwest, the cyclone moves eastward and the weather in southern California clears.

Mr. R. H. Weightman, whose helpful comments on this paper when in manuscript form deserve acknowledgment, remarked in this connection that "European writers have found, and it has been substantiated by our studies here (Washington, D.C.) that the movement of LOWS is more directly associated with air currents between 500 m and 2,500 m in the eastern half of the LOW, than with those in the western half, especially when the LOW has a warm sector." This is precisely what one would expect of low-level cyclones moving over a not too mountainous terrain. For our ultramountainous West it does not apply, and forecasters in the Far West are compelled to depend on wind data around the 4,000 m level for the most reliable clues of storm travel.

Examples like the foregoing, illustrative of the part played by the two great air streams—the north and the west—merely stress familiar facts, but facts important enough, perhaps, to bear repetition, and whose reiteration may even now be helpful in stressing the fact that it is the flow of air currents and their interaction which are our primary concern, rather than surface phenomena. In the "great rivers of air" over our heads, to borrow an expression of Maj. E. H. Bowie, is to be found the answer to the weather forecaster's most pressing problems; and while these rivers are often to be inferred from the isobaric patterns on the synoptic charts, the balloon data frequently serve to bridge over the inferential gap and acquaint the forecaster directly with much that he needs to know.

In the plotting and anticipation of these rivers of air, so important to the success of short-period weather forecasting, must we not ultimately find, if it is found at all, the key to the greater problem of long-period forecasting? Weather types are essentially air-flow types, and the persistence of a weather type is consequent upon the persistence of an air-flow type. The recent cold and snowy winter (1931–1932) in the Pacific States is an example. It was prolific of depressions which appeared in the far North or Northwest and moved southward along or near the Pacific coast. Obviously the controlling air currents, of which the depressions were peripheral phenomena, were persistently from a north or northwest quarter and constituted a very extraordinary south or southeastward movement of air over the northeast Pacific Ocean during the wettest part of the winter. A survey of synoptic charts and pressure graphs for this period confirms this inference in the persistence they show of high pressure offshore and low pressure over the far western portions of the United States and Canada. The Pacific coast seemed, much of the time, to lie in a "low-pressure lane" created and maintained by the southward flowing aerial river immediately to the westward.

In contrast to this was the excessively dry fall and winter of 1929–30. During the dry part of the period the reverse of the foregoing situation with respect to air streams evidently prevailed. Charts and pressure graphs showed a marked preponderance of high pressure over the far western portions of the United States and Canada, and about the usual amount of low pressure, if not more, at sea—clear evidence of a dominating flow of air from the south or southwest along and off the Pacific coast, which prevented disturbances from moving inland and carried them northward instead. The "low-pressure lane", to the extent which any existed, lay necessarily on the west side of this current, leaving the Pacific States and British Columbia in a dry zone so long as the aerial river, which was responsible, persisted in the position and course described.

THE RELATION OF JUNE TEMPERATURE TO THE MATURING OF CORN IN IOWA

By CHARLES D. REED

[Weather Bureau, Des Moines, Iowa]

[Author's Abstract]

The extent of autumn frost damage in Iowa is largely determined by the mean temperature of the previous June. In every one of the 12 cases when the June mean temperatue was 2°, or more, above the average, 69.4°, during the 43 years from 1890 to 1932, 95 percent, or more, of the corn escaped frost damage.

In 21 years out of 22, with June mean temperature normal, 69.4°, or higher, the percentage of corn not frosted was greater than the 43-year average of 87.3 percent. Except in 1923, when 75 percent was not frosted, 90 percent, or more, escaped frost damage in all of the 22 years.

A June mean temperature of 67° (2.4° below the average of 43 years) roughly divides the years in which 90 percent, or more, of the corn matured safely, from those having the most serious frost damage. Thirty-two Junes had temperatures above 67°, and in 29 of them 90 percent, or more, of the corn escaped frost.

All of the outstanding years of frost damage had a June mean temperature below 67°. In the order of rank, the worst 5 years were 1924, with only 33 percent not frosted; 1915, 35 percent; 1902, 48 percent; 1917, 49 percent; and 1912, 66 percent. There were 11 years with June mean temperature below 67°, and in 9 of these more that the average amount of corn was frosted.

RAININESS CHARTS OF THE UNITED STATES

By Eric R. Miller

[Weather Bureau, Madison, Wis.]

Raininess is the average rainfall per rainy day, rainy day being defined in turn as one with 0.01 inch or more of rain or melted snow.

The average raininess of the United States for the 4 seasons and for the year is shown on the 5 charts accompanying this paper. The data from A. J. Henry, climatology of the United States (Bulletin Q, U.S. Weather Bureau) of average rainfall and average number of rainy days, were employed in computing the raininess because they appear side by side in that publication.

Data from both regular and cooperative stations were worked up, but the results from the cooperative stations proved to be too inconsistent for use on the charts. This inconsistence results from the large variation in the number of rainy days recorded by cooperative observers to which I have previously drawn attention (M.W.R. 43, 1915, 275–278). The difference between cooperative and regular stations is greater in winter than in summer. The following table contains a few of the more extreme cases noted in preparing these maps.

Comparative raininess at regular and cooperative stations.

Station	Winter			Summer			Year		
	Rain-fall	Rainy days	Rain-iness	Rain-fall	Rainy days	Rain-iness	Rain-fall	Rainy days	Rain-iness
Baltimore, Md	10.0	34	0.29	12.7	33	0.39	43.4	131	0.33
Darlington, Md	10.5	18	.58	12.0	23	.53	43.8	82	.54
Jupiter, Fla	9.3	28	.33	16.6	39	.43	58.7	134	.44
Miami, Fla	8.1	9	.90	20.6	22	.94	58.3	65	.90
San Luis Obispo	10.3	19	.54	.1	0	------	19.2	42	.46
Santa Barbara, Calif	10.0	11	.91	.1	1	.10	16.6	27	.61
Springfield, Ill	7.6	29	.26	10.0	28	.36	37.4	117	.32
Griggsville, Ill	6.3	15	.42	10.9	19	.58	37.0	73	.51
Duluth, Minn	3.3	32	.10	11.6	37	.33	29.9	133	.22
Mount Iron, Minn	2.9	12	.24	13.8	26	.53	33.3	74	.45
North Platte, Nebr	1.3	15	.09	8.1	26	.31	17.9	79	.23
Ansley, Nebr	1.8	9	.20	10.3	21	.49	23.0	57	.40
Abilene, Tex	3.4	14	.24	7.0	19	.37	24.5	66	.37
Menardville, Tex	3.3	6	.55	6.9	10	.69	22.6	35	.65

Comparison of the maps of raininess with the maps of precipitation and of number of rainy days in the Atlas of American Agriculture, part 2, section A, Precipitation and Humidity, by J. B. Kincer, shows that raininess is more uniformly distributed than rainfall. This results from the fact that rainfall and number of rainy days tend to vary together, so that the result of dividing one by the other shows less fluctuation. The mountain maxima of rainfall do not appear in the raininess charts.

The number of rainy days is relatively greater in the Northeastern States than in the Southern. Hence the gradient of raininess from the Gulf States to the Lake region is somewhat steeper than the gradient of rainfall.

The annual march of raininess varies from the interior toward the oceans. In the interior the raininess is smallest in winter, but is then largest on the Pacific slope. The North Atlantic States have relatively uniform raininess throughout the year, but in the Gulf States winter and spring exceed summer and autumn.

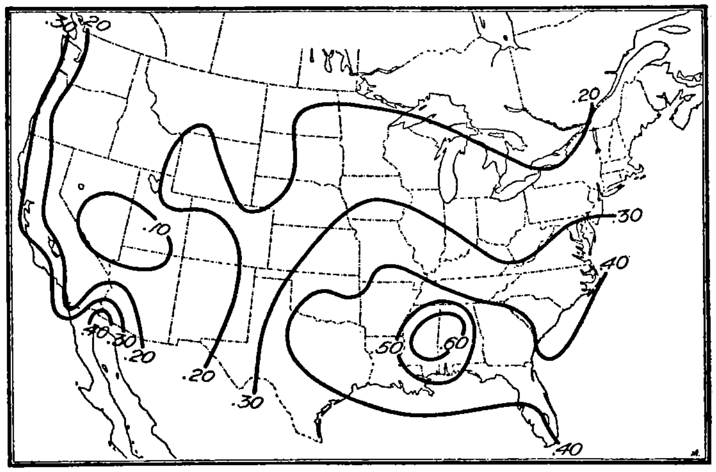

FIGURE 1.—Raininess chart of the United States—spring.

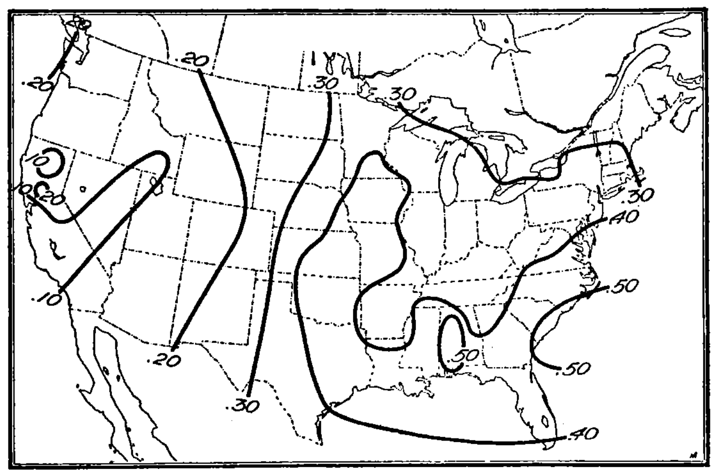

FIGURE 2.—Raininess chart of the United States—summer.

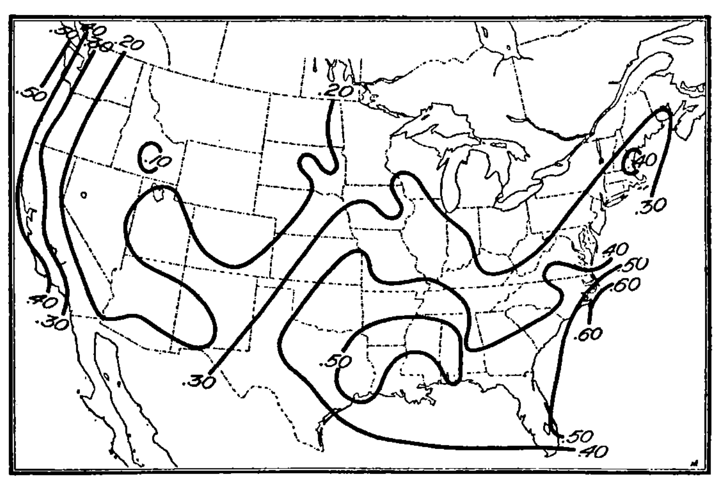

FIGURE 3.—Raininess chart of the Unitd States—autumn.